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PESTICIDE SALES IN LOW-INCOME, MINORITY NEIGHBORHOODS

Elizabeth J. Carlton, BS; Harmon L. Moats, BA;
Marian Feinberg; Peggy Shepard, BA;
Robin Garfinkel, PhD; Robin Whyatt, DrPH; David Evans, PhD

ABSTRACT: The US EPA has phased-out residential use of two organophosphate pesticides commonly used to control cockroaches—retail sales of chlorpyrifos were scheduled to end on 12/31/01, and diazinon on 12/31/02. In light of recent findings highlighting the associations between pests, pesticides and health, we surveyed stores in low-income, minority neighborhoods in New York City to determine whether the phase-outs have been effective and to assess the availability of alternatives to spray pesticides. In summer 2002, when sales of chlorpyrifos were illegal and diazinon still legal, we surveyed 106 stores selling pesticides. Four percent sold products containing chlorpyrifos and 40 percent sold products containing diazinon. One year later, when sales of both pesticides were to have ended, we surveyed 109 stores selling pesticides in the same neighborhoods and found chlorpyrifos in only one store and diazinon in 18 percent of stores, including 80 percent of supermarkets surveyed. At least one form of lower toxicity pesticides, including gels, bait stations and boric acid was available in 69 percent of stores in 2002. However sprays were most widely available, found in 94 percent of stores in 2002 and less expensive than lower toxicity baits and gels. In a separate survey of storekeeper recommendations conducted in 2002, storekeepers recommended lower toxicity pesticides as the best way to control cockroaches 79% of the time. The EPA's phase-outs have nearly eliminated sales of chlorpyrifos, but the diazinon phase-out appears to be less effective.

KEY WORDS: pesticides; pest-control; United States Environmental Protection Agency; chlorpyrifos; diazinon.

Elizabeth Carlton is Program Coordinator at the Columbia Center for Children's Environmental Health, Harmon L. Moats is Director of the Heart of Harlem Project, Robin Whyatt is Assistant Professor in the Department of Environmental Health Sciences all at the Mailman School of Public Health at Columbia University, New York, NY; Marian Feinberg is Health Coordinator at South Bronx Clean Air Coalition, Bronx, NY; Peggy Shepard is Executive Director of West Harlem Environmental Action Inc., New York, NY; Robin Garfinkel is Associate Research Scientist at Columbia College of Physicians and Surgeons; David Evans is Professor of Clinical Sociomedical Sciences at Columbia University College of Physicians and Surgeons and Mailman School of Public Health. H. Moats, M. Feinberg and P. Shepard are members of the Community Advisory Board at the Columbia Center for Children's Environmental Health.

Requests for reprints should be addressed to Elizabeth Carlton, Columbia Center for Children's Environmental Health, 60 Haven Avenue B-1, New York, NY 10032; e-mail: ec2060@columbia.edu.

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INTRODUCTION

Recent scientific findings that both cockroaches and pest control products have adverse health effects underscore the need for safe and effective methods of cockroach control. In low-income, urban communities, exposure to high levels of cockroach allergen has been associated with increased asthma morbidity.[1,2] The organophosphate pesticides chlorpyrifos and diazinon, commonly used to combat cockroaches, have been associated with adverse effects on growth and development in animal models[3,4,5] and chlorpyrifos has been associated with reduced birth weight and birth length in humans.[6] Residential spray applications of chlorpyrifos may lead to infant and child exposures that exceed the established reference dose.[7,8,9]

Community concern about the health effects of pests and pesticides is high. Focus groups with residents of low-income, urban neighborhoods in Northern Manhattan decided pest control should be one of three top neighborhood priorities.[10] A street survey conducted in the same neighborhoods showed that more than 95 percent of residents interviewed considered cockroaches and household pesticides to be health hazards.[11]

In recent years there has been a policy-based effort to reduce the toxicity of cockroach-control products. In 2000, the Environmental Protection Agency reached an agreement with manufacturers of the organophosphate chlorpyrifos to phase out indoor and outdoor residential use of the pesticide, ending retail sales December 31, 2001.[12] A similar agreement was reached for the organophosphate diazinon in 2001. Retail sales of diazinon for indoor use were scheduled to end December 31, 2002.[13]

The Columbia Center for Children's Environmental Health's (CCCEH) Healthy Home Healthy Child campaign has been recommending the use of lower toxicity pesticides and integrated pest management methods to women in Northern Manhattan and the South Bronx, two low-income communities in New York City with large African-American and Latino populations.[10,11,14] The campaign includes seven messages aimed at informing women how they can reduce their exposure to environmental toxicants. The CCCEH Community Advisory Board (CAB), representing eight organizations that serve the communities within Northern Manhattan and the South Bronx, plays a key role in the campaign—participating in the development of campaign themes and materials and delivering campaign messages at community workshops and health fairs.

The current survey grew out of a meeting between CCCEH researchers and members of the CAB. In evaluating the Healthy Home, Healthy Child campaign pesticide recommendations, CAB members ex-

pressed concern about the efficacy of the EPA's regulatory action in reducing chlorpyrifos and diazinon sales in the low-income, minority, urban neighborhoods that we were targeting. CAB members also cited the need to understand whether the alternatives to spray pesticides that we recommend, particularly gels, bait stations and boric acid, are accessible and affordable to community residents.

To answer these questions, we designed a survey of stores in four low-income, minority neighborhoods in Northern Manhattan and the South Bronx: Washington Heights and Harlem in Northern Manhattan, and the Hub and East Tremont in the South Bronx. Community Advisory Board members and CCCEH researchers jointly designed the survey. We designed this collaborative, community-based survey to answer the following questions: Has the EPA ban eliminated chlorpyrifos and diazinon sales in low-income, minority neighborhoods? To what extent are lower toxicity pesticides such as bait stations, gels and boric acid available in Northern Manhattan and the South Bronx, and how does their price and availability compare to bombs, foggers and sprays? Do different types of stores sell different types of cockroach control products? Finally, we included a question to explore the role store clerks might play in an expanded campaign—what types of pest-control products do storekeepers recommend to clients?

METHODS

In June and July 2002, a team of three researchers fluent in Spanish and English surveyed 135 stores in commercial areas within Northern Manhattan and the South Bronx. Surveyors canvassed 74 blocks over eight days. The Institutional Review Board of Columbia-Presbyterian Medical Center approved the research protocol.

Sampling locations were selected based on CAB recommendations. CAB members recommended popular commercial areas serving the four selected neighborhoods within Northern Manhattan and the South Bronx. Our goal in drawing this convenience sample was to capture a cross-section of shopping locations—including areas popular because of their concentration of stores and areas convenient because they offer the closest cluster of stores to a residential area. We surveyed five types of stores where household pesticides can usually be purchased: bodegas (convenience stores), discount stores (typically 99 cent stores), hardware stores, pharmacies, and supermarkets.

Within each commercial area, stores were randomly selected to be

surveyed. We started at one end of the area and walked towards the other end, sampling the first three stores encountered on each block that matched our store-type criteria. If a block had fewer than three stores matching our criteria, all such stores on the block were surveyed. Supermarkets were surveyed separately in the same areas. Because they are less commonly found than other store-types, all supermarkets encountered were sampled.

In each store, researchers examined all products being sold to control cockroaches by looking for displays of products marketed for cockroach-control and asking store clerks if they kept any products behind the counter to get rid of cockroaches. We noted the presence or absence of five different types of pesticides: bait stations, boric acid, aerosol bombs or foggers, gels, and sprays (both aerosol and pump). Only products being sold to control cockroaches were counted. Because supermarkets are larger and we were able to take notes within the store, the price of all products was noted in supermarkets. We recorded the store-type and neighborhood of each store.

The labels of all cockroach-control products found were checked for chlorpyrifos and diazinon by looking for common and chemical names. Products were classified as containing chlorpyrifos if the label read: chlorpyrifos, dursban, or O,O-Diethyl-O-(3,5,6-trichloro-2-pyridinyl) phosphorothioate. Products were classified as containing diazinon if the label read: diazinon or O,O-Diethyl O-(2-isopropyl-6-methyl-4-pyrimidinyl) phosphorothioate. Upon leaving the store, researchers recorded the brand name of each product found containing chlorpyrifos or diazinon, the price, type and quantity available on the shelves. We repeated this survey in August 2003 to assess the availability of chlorpyrifos and diazinon, sampling 133 stores in the same neighborhoods using the same research protocol used in the 2002 survey.

In June 2002, we also conducted a separate survey of 61 stores in the same neighborhoods to ask storekeepers what products they recommend to control cockroaches. We used the same sampling methods except that supermarkets were not surveyed. In stores where a storekeeper was available, a research worker explained to the clerk that he or she had a serious roach problem and then asked the clerk what he or she recommended they buy to get rid of the cockroaches. In stores where no clerk was available—for example, stores that were crowded with long lines and few store clerks—the survey was not conducted. We used this exclusion method because in overcrowded, understaffed stores, patrons are unlikely to ask for purchasing advice. We recorded the recommendation, store-type and neighborhood.

While conducting the 2002 surveys, we noticed that many products containing diazinon omitted the common name, listing only the chemical name. To assess how common this labeling practice is, we retrospectively surveyed supermarkets in two of the four survey neighborhoods for the 12 diazinon-containing products found in the original survey. When the product was found, the exact label was copied.

Data Analysis

Most of the questions in our survey were answered by examining frequency distributions without statistical analyses. Data from the two neighborhoods in the South Bronx were pooled and analyzed as single South Bronx neighborhood category because of the relatively smaller number of stores sampled. Stores were classified as selling lower toxicity pesticides if they sold at least one of the following products: boric acid, bait stations or gels. Stores were classified as selling higher toxicity pesticides if they sold bombs or foggers, or spray pesticides. Unless otherwise specified, all percentages are calculated as a percent of the stores that sell pesticides.

We used chi-square tests of significance for categorical analyses. In the case of the 2002 analyses, we conducted chi-square analyses twice, once including and once excluding hardware stores since only 8 hardware stores were sampled. Because of the limited number of stores selling diazinon in 2003, we compared supermarkets to all other store types using Fisher's Exact Test to examine diazinon sales by store type. Analyses of 2002 diazinon sales and low-toxicity pesticide sales were supplemented by logistic regression analyses that included both neighborhood and store type to examine the impact of store-type and neighborhood. All tests of statistical significance were two-sided with alpha = 0.05.

To calculate the average price of each pesticide product, we calculated the mean store price of each product in each supermarket where it was available. The mean store price of each product was then averaged to calculate the mean product price. The standard deviation of the mean product price was calculated from the distribution of mean store prices.

RESULTS

Table 1 shows the distribution of stores sampled in 2002. Bodegas were the most commonly sampled store-type (62 stores), and hardware stores the least commonly sampled (8 stores). Of the 135 stores sampled,

TABLE 1

Total Number of Stores Sampled in the 2002 Survey and Number and Percent of Stores Selling Pesticides by Store-Type

Store Type	*Stores Surveyed*	*Stores Selling Pesticides Number (Percent)*
Supermarket	18	18 (100%)
Discount (99 Cents)	30	29 (97%)
Hardware	8	7 (88%)
Bodega	62	41 (66%)
Pharmacy	17	11 (65%)
Total	135	106 (79%)

36 percent were located in Harlem, 27 percent in the South Bronx and 37 percent in Washington Heights. We found pesticides in 106 stores. Pharmacies were least likely to sell pesticides (65 percent), supermarkets most likely (100 percent).

Presence of Products Containing Chlorpyrifos in 2002

Chlorpyrifos-containing products were found in all three neighborhoods in a total of four stores: two hardware stores, one bodega and one pharmacy. Three distinct chlorpyrifos-containing products were found. All three products were sprays: two aerosol, one pump. Each of the four stores sold only one type of chlorpyrifos-containing product for cockroach control. Three of the four stores also sold products containing diazinon.

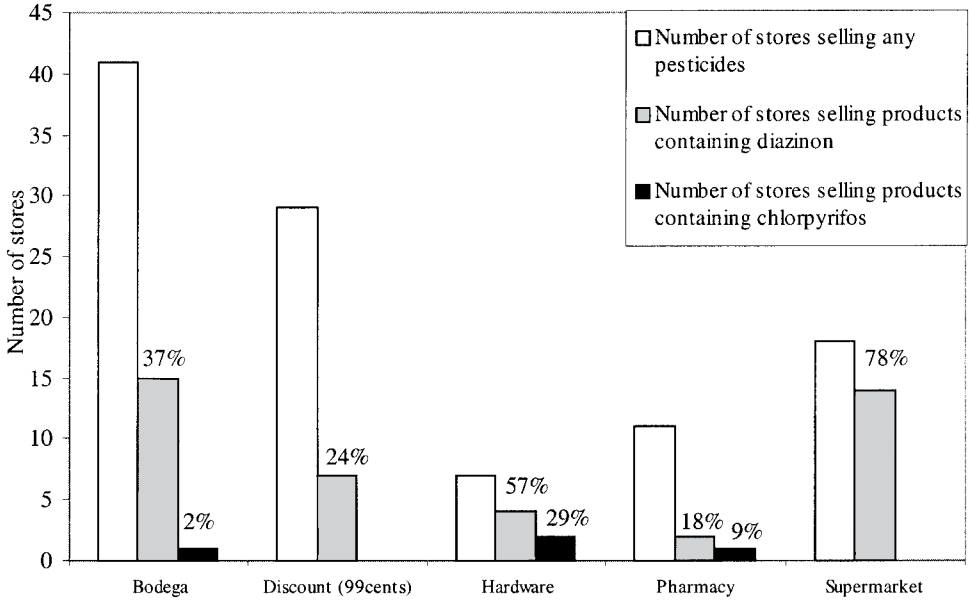
Presence of Products Containing Diazinon in 2002

We found products containing diazinon in 42 stores (40 percent). Diazinon-containing products were found in all three neighborhoods. We identified 12 distinct products containing diazinon, all were aerosol, spray pesticides.

Figure 1 shows the availability of products containing diazinon and the availability of products containing chlorpyrifos by the type of store. Chi-square analysis of the percent of stores selling diazinon showed significant differences in sales by store-type ($p = 0.002$ including hardware stores, $p = 0.001$ excluding hardware stores). Percentages of each store-type selling diazinon were: 78 percent of supermarkets, 57 percent of hardware

FIGURE 1

Number of stores selling products containing chlorpyrifos, diazinon, and any pesticides by store-type during summer 2002. Percentage of each store-type selling pesticides containing chlorpyrifos or diazinon are shown above each bar. The US EPA effective banned chlorpyrifos for retail sale effective December 31, 2001, and diazinon effective December 31, 2002.



stores, 37 percent of bodegas, 24 percent of discount stores, and 18 percent of pharmacies. A supplemental logistic regression model including both neighborhood and store type showed store type was a significant predictor of diazinon sales but that neighborhood was not (results available upon request).

Labeling of Diazinon-Containing Products

We were able to collect label information for 9 of the 12 products (we did not find 3 of the diazinon-containing products in our separate survey of supermarkets). Seven of the 9 products listed diazinon as "O,O-Diethyl O-(2-isopropyl-6-methyl-4-pyrimidinyl) phosphorothioate," omitting the more widely recognized common name, diazinon. Two products

listed diazinon as "Diazinon [O,O-Diethyl O-(2-isopropyl-6-methyl-4-pyrimidinyl) phosphorothioate]."

Availability of Different Cockroach-Control Products

Table 2 shows the availability of different products sold to control cockroaches by store-type collected in the 2002 survey. Sprays were found in at least 90 percent of all store-types. Other products showed strong variability in their availability by store-type. Hardware stores carried the greatest variety of products—all five products were available in over 70 percent of the hardware stores selling pesticides we sampled. Boric acid was widely available in discount stores (66 percent) and supermarkets (72 percent). Gels and bait stations had the lowest availability. We found gels in 30 percent of stores (31 percent of discount stores, 33 percent of supermarkets) and baits in 28 percent of stores (21 percent of discount stores and 39 percent of supermarkets).

Figure 2 shows lower toxicity and higher toxicity pesticide sales by store-type. We found 69 percent of all stores sold at least one type of lower toxicity pesticide. Chi-square analysis of the percentage of stores selling lower toxicity pesticides by store-type showed significant differences in availability of lower toxicity pesticides between store-types ($p < 0.001$ including and excluding hardware stores). Bodegas were least likely to sell lower toxicity pesticides: 41 percent offered lower toxicity pesticides compared to 86 percent of discount stores, 78 percent of supermarkets, 91 percent of pharmacies and 100 percent of hardware stores. A supplemental logistic regression model including both neighborhood and store type

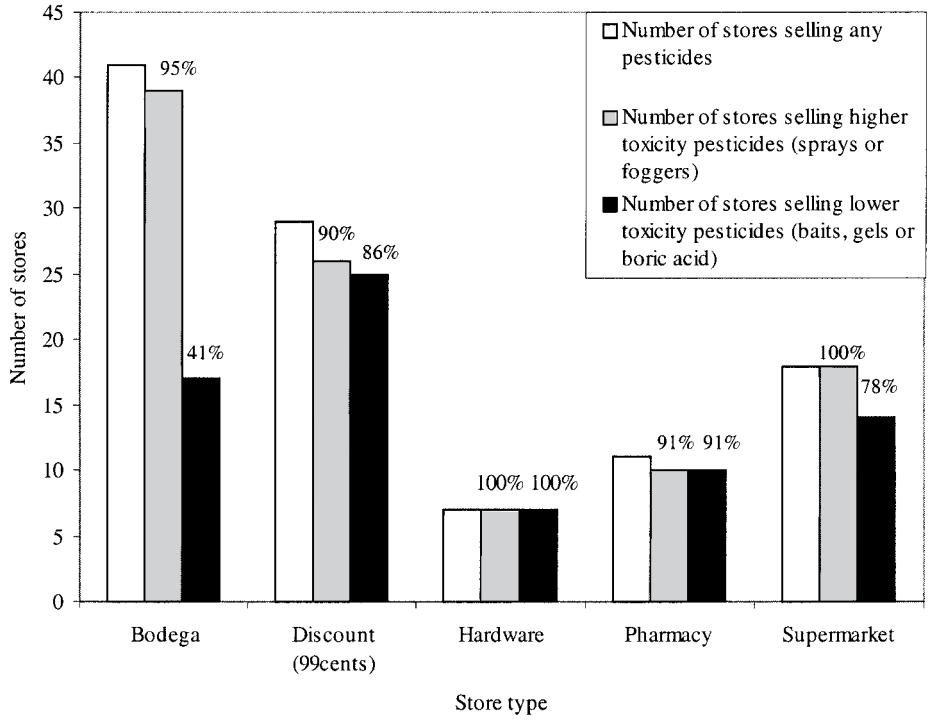
TABLE 2

Percent of Stores Selling Five Different Types of Cockroach Control Products by Store-Type in 2002

	Bait Stations	*Gel*	*Boric Acid*	*Fogger*	*Spray*
Supermarket (n = 18)	39	33	72	78	100
Discount (n = 29)	21	31	66	31	90
Hardware (n = 7)	86	71	71	71	100
Bodega (n = 41)	12	17	24	56	95
Pharmacy (n = 11)	55	45	55	45	91
Total Availability	28	30	50	53	94

FIGURE 2

Number of stores selling lower toxicity pesticides, higher toxicity pesticides, and any pesticides by store type in 2002. Percentage of each store-type selling lower toxicity pesticides and higher toxicity pesticides are shown above each bar.



showed store type was a significant predictor of low-toxicity pesticides sales but that neighborhood was not (results available upon request).

Twenty-eight percent of stores offered two or more types of lower toxicity pesticides. Eleven percent sold gels, bait stations and boric acid. Only 6 percent of stores limited their sales to lower toxicity pesticides (3 discount stores, 2 bodegas and 1 pharmacy). At least one higher toxicity pesticide, defined as sprays and foggers, were available in 94 percent of stores. The percent of stores selling higher toxicity pesticides ranged from 90 percent of discount stores to 100 percent of supermarkets and hardware stores.

The mean product price in supermarkets of each of the five cockroach control products that we surveyed showed bait stations (mean:

$6.29 ± $1.23), gels (mean: $6.07 ± $1.52), and foggers (mean: $6.30 ± $3.64) were at the top of the price range. There was wide variability in the price of foggers. Boric acid was the least expensive product (mean: $2.37 ± $0.45) and sprays (mean $3.58 ± $0.55) were priced in the middle of the range.

Storekeeper Pest Control Recommendations

Of the 61 stores we sampled in the separate survey asking for storekeeper advice, 58 stores sold pesticides (95 percent). We asked storekeepers what they recommended to control cockroaches in 26 of the stores selling pesticides (9 bodegas, 8 discount stores, 4 hardware stores, 4 pharmacies, and one store where the type was not recorded). In the remaining 32 stores, no storekeeper was available. We received a total of 28 recommendations (2 storekeepers each recommended 2 products). Twenty-two recommendations (79 percent) were for lower toxicity pesticides (12 recommended boric acid, 1 bait station, 9 gels). Six recommendations were for higher toxicity spray pesticides (5 recommended sprays, 1 recommended fogger).

Availability of Chlorpyrifos and Diazinon in 2003

In the survey conducted in summer 2003, we found products containing diazinon in 20 (18 percent) of the 109 stores selling pesticides that we surveyed (55 bodegas, 29 discount stores, 3 hardware stores, 12 pharmacies, and 10 supermarkets). There was a significant reduction in diazinon sales from 2002 to 2003 (40 percent vs. 18 percent, $p = 0.001$). Eighty percent of supermarkets sold diazinon, compared to 18 percent of bodegas, 3 percent of discount stores, 1 of 3 hardware stores and no pharmacies. On analysis, supermarkets were significantly more likely to sell products containing diazinon than other store types combined (80 percent vs. 12 percent, $p < 0.001$, Fisher's Exact Test). We identified 8 distinct diazinon-containing products in the stores we surveyed, all aerosol, spray pesticides. We found products containing chlorpyrifos in only 1 store, which offered two chlorpyrifos-containing products, both aerosol, spray pesticides.

DISCUSSION

EPA Phase-Out Evaluation

It appears the EPA's chlorpyrifos phase-out is working. Six-months after the retail ban took affect, chlorpyrifos was found in only 4 percent

of stores selling pesticides. A year and a half later, we found only one store selling chlorpyrifos. These remaining products show full compliance has not yet been achieved. It appears the EPA's diazinon phase-out has been less effective. The availability of products containing diazinon has decreased significantly since the ban, but we nonetheless found diazinon in nearly one in five stores eight months after sales were to have ended.

Availability and Cost of Different Products

Lower toxicity pesticides are available in most stores and recommended by the storekeepers we interviewed 79% of the time. But, while boric acid was available in 50% of stores, low-toxicity gels (30%) and baits (28%) were more difficult to find. Higher toxicity pesticides are available in 94 percent of stores selling pesticides, and sprays were the most common cockroach control product available.

Product price appears to influence availability. Sprays are a low-cost option compared to gels and baits and found in three times as many stores. When recommending alternatives to higher toxicity pesticides to low-income populations, cost and availability must be addressed. It would be helpful to explore the frequency of application for different pest-control products (for example, bait stations often last three months, sprays can be used daily) when comparing the costs of different products.

Implications for Educational and Regulatory Interventions

The labeling of most diazinon-containing products with only the chemical name makes it difficult for the consumer to recognize the chemicals in cockroach-control products. A consumer hoping to avoid products containing "diazinon" could easily purchase products that list diazinon only by its chemical name and think diazinon had been avoided. Educational campaigns to teach consumers to avoid certain chemicals must take into consideration such labeling practices. This finding has helped the CCCEH evaluate its own educational materials and recognize the need to revise the way chemicals are listed on pesticide fact-sheets.[9] Legislation requiring manufacturers to list the common names of chemicals on products would make educational efforts easier and more effective.

The advice given by storekeepers suggests an awareness of the potential dangers of spray pesticides and/or an appreciation of the increased effectiveness of gels, bait stations and boric acid. This is consistent with survey reports that a high proportion of respondents in Northern Manhattan regarded pesticides as posing a health risk.[10]

The survey showed distinct sales patterns by store-type indepen-

dent of neighborhood, some of which were surprising. Supermarkets were the most likely to sell products containing diazinon and would be an appropriate target for an educational campaign about new regulations. Discount stores, long suspected of being retailers of more toxic pesticides, were among the least likely to sell diazinon and 86 percent sold lower toxicity pesticides. Bodegas, not discount stores, were the least likely to offer lower toxicity pesticides. In light of recent findings showing women who report using sprays and/or bombs can have increased levels of diazinon in the air they breathe,[15] bodegas would be an appropriate target for an educational intervention informing storekeepers about lower toxicity pesticides, including less expensive options such as boric acid.

Limitations

This study was conducted using convenience sample of stores in low-income areas of CCCEH target communities. Although we attempted to sample different types of commercial areas, isolated stores on residential blocks are largely missing from this survey. It is possible that such stores have a slower product turnover and might be more likely to have older, chlorpyrifos-containing pesticides on the shelves.

Pesticides purchased to combat cockroaches account for only part of residential pesticide exposure. Exterminator services hired by landlords and individual residents also contribute to residential pesticide exposure. Assessing the success of the EPA phase-out in reducing use of chlorpyrifos by commercial pesticide operators was beyond the scope of this study.

Anecdotally, we found 3 products containing chlorpyrifos marketed to combat non-cockroach pests such as ants, fleas and hornets during the survey. We excluded these products from our analyses because they were not marketed to combat cockroaches. Cockroach-control products, are not the only source of exposure from retail pesticides.

CONCLUSION

The EPA's phase-out of retail sales of chlorpyrifos and diazinon appears to have all but eliminated sales of chlorpyrifos and significantly reduced the availability of diazinon in the low-income, minority neighborhoods in which we conducted the survey. Total compliance, however, has not yet been achieved. Considering the complex labeling practices we noted, regulatory action appears to be an effective means of eliminating at least one component of residential exposure to particular chemicals.

Despite the near universal availability of higher toxicity pesticides, lower toxicity pesticides are widely available in the areas we surveyed. We found lower toxicity pesticides in more than 75 percent of stores in every store-type we sampled except for bodegas (41 percent). While sprays are less expensive than bait stations and gels, the difference in price ignores efficacy and duration of treatment. In addition, the fact that storekeepers tended to recommend lower toxicity pesticides is encouraging and demonstrates the importance of educational campaigns. CAB members and CCCEH researchers are using the information from this survey to formulate campaign initiatives directed at storeowners and community residents.

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